

# Argonne National Laboratory-East

## Summary Site Environmental Report for Calendar Year 2003



ANL-04/2 (Summary)



**Office of  
Science**

U.S. DEPARTMENT OF ENERGY



THE UNIVERSITY OF  
**CHICAGO**



**ARGONNE**  
NATIONAL LABORATORY

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# Message to the Reader

By Jennifer Matkovich

Dear Reader,

It is not often we are given the opportunity to put all our time and energy into the completion of a project that will have a great impact on hundreds of individuals. We, the juniors and seniors in Mrs. Kathleen Luczynski's Biology II classes of Downers Grove South High School, were ecstatic when told we would have the opportunity to become involved with a valuable project that would not only apply to our course curriculum, but would also help Argonne National Laboratory and the public. The challenge we were asked to undertake was the creation of this summary book — a condensed, colorful, and easy-to-read companion to the 2003 Site Environmental Report for Argonne National Laboratory-East. This summary book would be used for worldwide distribution by Argonne scientists and appear at public forums, in grant writings, and at national and international conferences.

Biology II is a class designed for students who desire to learn about emerging issues in biological science. Students work individually and in groups to answer questions and solve problems that relate to biology using various technological resources. In our ongoing desire to know and apply concepts that describe the interactions between science, technology, and society, we were asked to describe the effects that projects at Argonne have on the surrounding community based upon data drawn from their environmental studies. The task of condensing a complicated technical report into something more manageable and easy to read for the public was quite a challenge.

Armed with the wide arsenal of highlighting, note-taking, and summarizing skills we acquired from our class, we worked in pairs to tackle our assigned sections. Although we experienced initial frustrations in understanding and condensing the book's sections, we were eventually able to submit a first draft of our work to Argonne scientist Norbert Golchert and science writer David Baurac. Through ongoing e-mails with the scientists, students were able to receive helpful feedback on their work throughout the process. After some editing, revisions, and additions to their initial work, students eventually sent the



*Biology students at Downers Grove South High School participated in creating this report. In the top back row, from left to right, are Russell Vilorio, Jennifer Wang, Lauren Masterson, Farrah Grysbeck, Lydia Henderson, Alexandra Shabnasarian, Lindsey Merrick, Jennifer Matkovich and Jessamyn Marino. In the middle row, from left to right, are Meghan Callham, Sajitha Abraham, Ashley Bartel, Laura Grabowski, Nakita Pasquesi, Lauren Rajski, Kaye Maloney, Kerri Holland and William Wysocki. In the front row, from left to right, are Victoria Carr, Duy (Lem) Ngo, Sheryl Foster, Mrs. Kathleen Luczynski, Leanne Miller and Rachael Bosman.*

final drafts of their summarized sections to Argonne for publication in this book.

We would like to thank all the individuals who helped us with the development of this work. The assistance Dr. Golchert and Mr. Baurac provided was valued and appreciated by all who participated in the project. Additionally, we would like to acknowledge Dr. Dombrowski who aided us in the brainstorming process that paved the way for the completion of our work. Last but not least, Mrs. Luczynski's undying enthusiasm, encouragement, and planning were greatly valued by everyone. Without the help of these individuals, we would have been unable to produce the book in front of you today.

The creation of this book has been an unforgettable experience. It has changed the way we read, write, observe, and contemplate. A result of our hard work and dedication, we proudly present to you this summary book and hope it will inspire you as well to become more actively involved and interested in the pursuit of scientific knowledge.

*For more information about Argonne's Site Environmental Report, contact Norbert Golchert at (630) 252-3912 or [ngolchert@anl.gov](mailto:ngolchert@anl.gov). For more information about Argonne and its programs, visit the laboratory's World Wide Web site at [www.anl.gov](http://www.anl.gov) or contact Communications & Public Affairs at (630) 252-5575. Photos by George Joch. The text was edited by David Baurac. Design and layout by Dave Jacqué.*

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# What is Argonne?

By Rachael Bosman and Kerri Holland

Have you ever driven by Argonne National Laboratory and wondered what it is and what happens there? Argonne is a research laboratory with more than 200 different programs in basic scientific research, advanced energy technology, environmental assessment and management, and national security.



*Downers Grove South Biology II students working in the fields of Argonne.*

Sawmill Creek runs through the site and enters the Des Plaines River, which flows along the forest preserve. Waterfall Glenn, which was once part of the Argonne site, also surrounds the laboratory and is used as a recreational area for the public.

## Where is Argonne?

Located on a 1,500-acre wooded site in the southeastern corner of DuPage County, Argonne is operated by the University of Chicago for the U.S. Department of Energy's Office of Science. It is located at 9700 South Cass Avenue in Argonne, Illinois. Much of Argonne is former prairie and farmland.

## What Does Argonne Do?

Argonne conducts research and development in many areas of basic and applied science. In 2003, Argonne employed about 2,700 people, including about 1,000 scientists and engineers. Many of Argonne's environmental researchers assist with the laboratory's programs in waste minimization, pollution prevention, and environmental stewardship and compliance.

## Environmental Conditions

Argonne monitors the climate in this area for temperature, precipitation, and wind direction and speed. The local geology consists of a broad valley, which is occupied by the Des Plaines River and the Chicago Sanitary and Ship Canal. The soil at Argonne is derived from glacial drift over the past 12,000 years.

## How Does Argonne Benefit the Community?

Argonne has a great impact on the local community and its surrounding environment. Argonne serves as a major source of employment for the area. Argonne is also a great resource for many students when performing different types of research projects. Many schools visit Argonne to participate in hands-on science and nature learning activities. Dozens of students enter the annual Rube Goldberg machine contest. For this contest, students construct a machine to perform a simple task by using many simple machines. Argonne also created an online site called "Ask a Scientist." This program allows students the chance to ask questions about topics they are studying in science and have them answered by a scientist.

# Current Research at Argonne

By Lauren Gurgone and Nakita Pasquesi

## Research Programs

The United States would not remain the world leader in science and technology without “user facilities,” advanced research facilities that are available to scientists and engineers from all over the nation. Argonne’s campus has many advanced research facilities, such as the Argonne Tandem-Linac Accelerator System. It’s the world’s first superconducting accelerator for the nuclei of heavy elements. In addition,

there is the Electron Microscopy Center where scientists focus on materials research and develop advanced technique and instruments. The Intense Pulsed Neutron Source is known for its achievements in neutron scattering. Argonne also manages the Atmospheric Radiation Climate Research Facility, which is the largest global change research program supported by the U.S. Department of Energy. The Center for Nanoscale Materials focuses on nanomaterials, which are made of materials one-billionth of a meter or smaller in size.

Argonne’s premier user facility is the Advanced Photon Source (APS). At this facility, scientists from all over the world conduct research in materials and biological science, physics, chemistry, environmental science, geophysical and planetary science, and X-ray instrumentation. Companies such as Saturn and Amoco have used the APS.

At these facilities, numerous research projects are underway. Use of brilliant X-rays at the APS has enabled scientists for the first time ever to obtain videos of insect breathing. X-rays have also determined the first structure of the main protease from the virus that causes SARS. Another project in progress is the understanding of protein functions. This is where scientists work to determine the three-dimensional structure of proteins of the human genome.

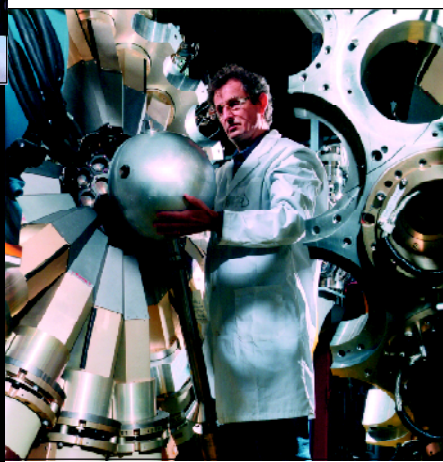
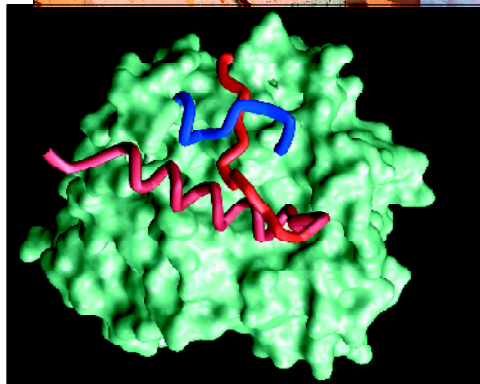
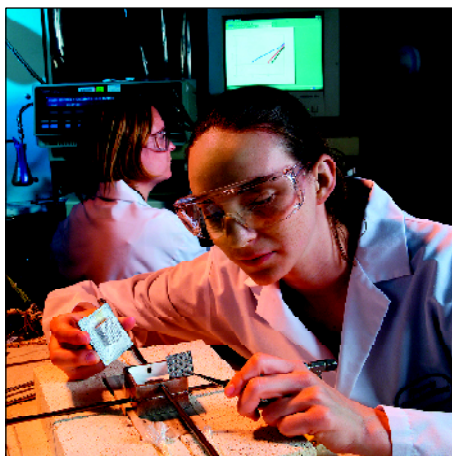
In addition, scientists discovered a shock wave in gas sprays that may lead to more efficient engine fuel-injection systems. Argonne uses X-ray beams to penetrate diesel fuel-injector sprays to study and improve engine combustion.

Other research projects study materials under pressure, biological structures, and new forms of ice.

Around the world, more than 750 million people live in urban areas without adequate housing. What if it were possible to produce a high-quality and low-

cost material that would provide affordable housing for developing nations?

Through joint research with Casa Grande LLC, Argonne developed Grancrete, a material twice as strong as concrete, fire resistant, and able to withstand severe weather. The cost of building a simple home with Grancrete walls is far less than building a typical home. Grancrete shows how research performed at Argonne can improve the quality of life and economy across the world.



*A few examples of current Argonne research: top, Argonne’s patent-pending TuffCell converts the chemical energy of a fuel, such as hydrogen, into electrical energy with little or no emission of pollutants. At right is Gammasphere, the world’s most sensitive gamma-ray detector, used for studies of the atomic nucleus. At left, this knotted protein comes from a microorganism called *methanobacterium thermoautotrophicum*. Argonne researchers are developing automated tools to speed the process of determining the three-dimensional structure of proteins.*

# Environmental Monitoring

By Victoria Carr and Ashley Bartel

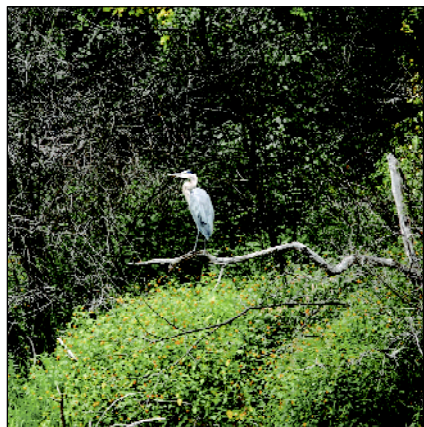
Is it possible that Argonne National Laboratory is unknowingly polluting the local environment? In order to make sure that this does not occur, Argonne conducts a year-round environmental monitoring program that is regulated and directed by governmental agencies, such as the Environmental Protection Agency. At Argonne, the scientists and workers monitor the local ecosystems. Argonne truly does not want to harm the environment, wildlife, ecosystems, its employees, or the local communities in any way.

## What is environmental monitoring?

Argonne's environmental monitoring program tests and samples the local ecosystem and environment to make sure that the laboratory is not releasing any toxic chemicals or other pollutants. Some ecological components that Argonne monitors include water, air, bottom sediment, waste, and radiation.

How does this impact people in the surrounding communities?

Many of Argonne's scientists live near the laboratory site, and therefore, if there are any harmful substances being released, Argonne needs to find out about them so



*A heron perches near Sawmill Creek on the Argonne site.*

that employees and neighbors are safe. Also, environmental monitoring makes citizens aware of what is going on or what could happen. People need to know if there are any dangers that they should be concerned about.

Does monitoring preserve the natural resources

of Argonne?

Yes. If there are any pollutants that are killing or harming any of Argonne's natural resources, researchers can stop, control, or contain the chemicals being released. Some plants or natural resources may be at



*Flowers bloom near Argonne's administration building.*

risk, and therefore, scientists need to make sure that no wildlife is being harmed, killed, or sickened. Argonne's environmental monitoring program uses a variety of instruments that measure contaminants found in the environment by collecting small samples from the environment and analyzing them for chemical and radioactive materials. Argonne collected 2,227 samples and conducted 28,800 analyses in 2003.

## Environmental Compliance

Argonne's Environmental Remediation Program was designed to achieve compliance with all environmental requirements that relate to cleaning up hazardous materials from the laboratory's waste sites.

The U.S. Department of Energy and the University of Chicago worked with Argonne to create a performance-based contract. Under this contract, DOE annually evaluates Argonne and its operations. Each year, Argonne is given a rating of Outstanding, Excellent, Good, or Marginal for:

- Compliance with the laboratory's environmental permits
- Compliance with environmental project schedule
- Compliance with project cost
- Compliance of the laboratory's environmental management system

Argonne's most recent rating for each of these categories was Outstanding, the highest possible. Argonne is in compliance with the law, and regulates and checks its site frequently to make sure its environment is safe for everyone.

# Air Monitoring

By Lem Ngo and Jen Wang

Imagine living in a world with air that is contaminated with an excessive amount of pollution. What would one do in such a situation? Argonne National Laboratory conducts air-monitoring procedures constantly to observe and record the quality of air on and around its site. Argonne must deal with air pollution under strict guidelines and careful observations. The purpose of air monitoring is to measure and track air quality and pollution.

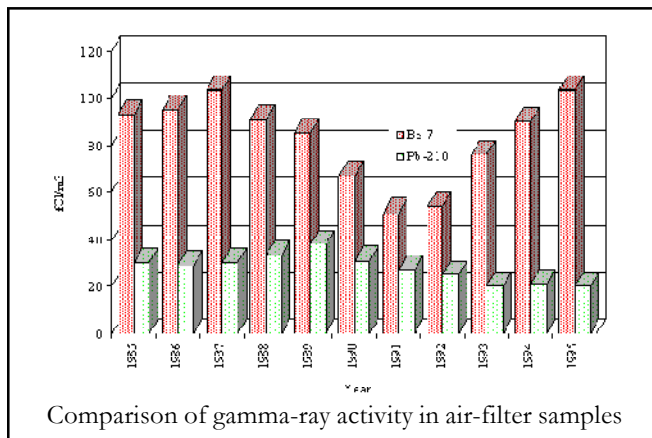
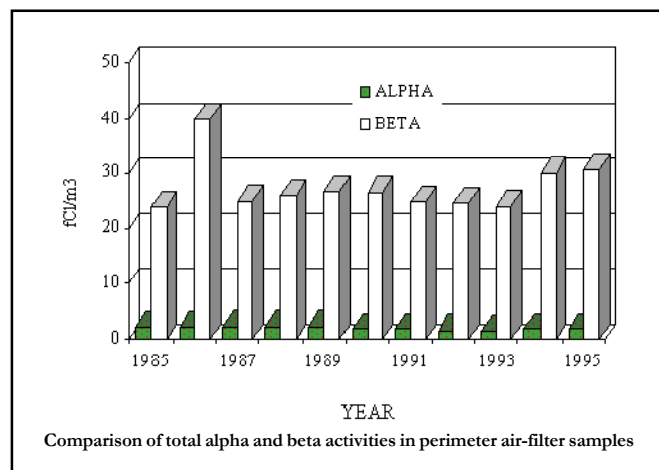
## Compliance

Federal law requires Argonne to comply with the Clean Air Act (CAA). The CAA is a federal law that restricts and controls the amount of hazardous air pollutants (HAPs) emitted into the air. Within the Clean Air Act is the Clean Air Act Permit, which regulates the emissions at the facility, including carbon monoxide, particulates, volatile organic compounds, HAPs and ozone-depleting substances.

Argonne's air monitoring program has stations within Argonne and at off-site locations. The program collects and monitors airborne releases coming out of Argonne that may be harmful to humans and other organisms in the local ecosystem. Such emissions may include carbon monoxide, volatile organic substances, and radionuclides.

## Equipment and Requirements

Employees at Argonne monitor air by using specific equipment to measure possible radionuclide releases that



might affect the public. When collecting samples, tools like detector tubes can be used to monitor airborne effluents. Effluents include both radionuclides and conventional pollutants. This information is then recorded and transferred to the data-management system. The air must be monitored continuously and filters checked each week for contamination. It is essential to monitor air because radioactivity is primarily transported by air and water.

Argonne also uses a variety of equipment to monitor the exposure of employees to radiation while on the job. Past data indicates that Argonne employees may receive more radiation than the general public. However, employees do not receive more than the safety standards.

## ICRP

The International Commission on Radiological Protection set standards to protect the public from exposure to excessive radiation. The current standard for safe exposure to airborne radiation is 10 mrem/yr. Argonne tries to keep the doses as low as possible and well under this 10 mrem limit. In 2003, the maximum exposure that any member of the public might have received as a result of airborne radiation from Argonne was 0.057 mrem; this is 175 times lower than the 10 mrem safe limit. The graph at left shows how much alpha and beta samples were found in filters and the graph above shows how much gamma radiation was detected.

So the answer to the question, "what does one do in such a situation" is, professionals from Argonne and other scientists around the world continuously watch air quality to make sure the air is safe.

# Water Monitoring

By Laura Grabowski and Lindsey Merrick

In developing nations, 80 percent of diseases are water-related. One gram of a common household herbicide can contaminate 10 million liters of drinking water. Most of us have experienced water with “something else” in it. Although most water contains substances that make it less than 100 percent pure, these substances are mostly harmless. At Argonne, the water is kept safe, because it is treated and monitored. Argonne scientists use several processes to ensure that the facility is complying with the water-purity laws that have been set forth.

## The Clean Water Act

One of the major provisions that they work under is the Clean Water Act. The Clean Water Act (CWA) has been modified several times in order to keep it current. Many of the modifications deal with surface water. Before Argonne discharges any type of wastewater, each discharge point must comply with the set limits in Argonne’s permit from the Illinois Environmental Protection Agency (IEPA).

Under the CWA is the National Pollutant Discharge Elimination System, known as the NPDES. The NPDES permitting program works to cut down on water pollution. Argonne’s surface water is tested routinely, with results submitted monthly to the IEPA in a Discharge Monitoring Report. An NPDES permit from the IEPA is necessary for all Argonne’s wastewater discharge.

Compliance with the NPDES permit has been a struggle. Argonne has focused on monitoring and controlling waste water to ensure that it stays within permitted limits. Under NPDES, during winter months, the total dissolved solids in Argonne’s groundwater are elevated due to the use of salt to help keep roads ice-free for safe driving. Out of 1,600 measurements, three violations occurred in 2003. One was attributed to road salt, another to heavy rainfall, and the third went undefined. To help solve this occasional problem, an application to DuPage county allowed discharge of this water under a permit to the county wastewater treatment plant.

## Water Monitoring

By definition, water monitoring is keeping track of how safe and clean surface water is. At Argonne, samples are collected and tested to find what, if any, radionuclides

or hazardous chemicals used at Argonne are in the water samples taken from Sawmill Creek and wastewater outfalls throughout Argonne. After samples are taken, treated wastewater is discharged.

Water samples are tested in many ways for many chemicals. Each chemical requires a different test.

Liquid wastewater from buildings that use radioactive materials is collected in retention tanks. Once a tank is full, the water is tested; if the amount of radioactivity is above the allowable level, the water is evaporated, and the residue is disposed of as a solid waste. If the amount is below the release limits, the wastewater is sent to the laboratory’s wastewater treatment plant.

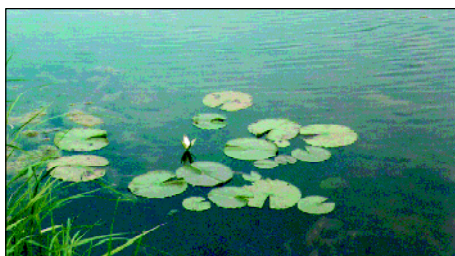
Many scientists and organizations monitor Argonne’s water. One of the organizations involved is the U.S. Environmental Protection Agency. However, at Argonne, the scientists are responsible for the job of keeping track of the water, their primary focus being Sawmill Creek, which flows across the Argonne site.

Sawmill Creek is a natural stream consisting largely of storm water runoff. In dry periods, the flow of the stream gets low. During these times, a large portion of the creek consists of Argonne wastewater and discharges. To ensure that limits are not exceeded, Argonne compares its analysis of Sawmill Creek water with IEPA General Use Water Quality Standards. Argonne checks for 15 different types of metals, along with measuring the pH. None of the results obtained for 2003 exceeded the General Use Water Quality Standards.

## Results

Argonne monitors both chemical and non-radiological contaminants. Argonne is under strict guidelines as to how much of each chemical or radiological substance can be in the water discharged into Sawmill Creek. All results show that Argonne is not adding radioactivity to the water. All the results for each different substance are at or below the safety standards.

Concentrations of chemical contaminants were also at or below the standards. The only concern was a small amount of acetone, which might have resulted from dumping chemicals down drains. Even though this is not permitted at Argonne, small amounts occasionally seep into the laboratory’s sewers.



# Groundwater

By Leanne Miller and Jessa Marino

Have you ever considered what is in your drinking water? Although the water coming out of the faucet may look clear to you, few people think about what is done to their water before it reaches their sink. Typically, groundwater makes up a large portion of the drinking water used by a community. Groundwater comes from precipitation that soaks into the ground. Basically, it is the water that is found under the ground in cracks or openings in the soil, rock, or sand. These materials are called natural aquifers; as the groundwater flows through them they naturally clean the water. Figure 1, at right, illustrates the location of groundwater.

Groundwater can be found practically everywhere. At Argonne National Laboratory, groundwater is tested and monitored for contamination in various sites around the Argonne area. Monitoring this water is important because if contaminated, groundwater poses a potential threat to the environment and its inhabitants. That includes your community, if you use groundwater.

## What has Argonne found so far?

In order to test the groundwater at Argonne, it must first be collected from various wells. A well is a pipe that has been drilled into the aquifer and left to fill with groundwater. The water is tested for a variety of different contaminants that may be harmful to humans. For example, several wells at the East-Northeast (ENE) landfill on the Argonne site were tested for chemical contaminants. These tests were conducted to make sure that all contaminants fell below those levels set by the Illinois Administrative Code (IAC). Both filtered and unfiltered samples were collected quarterly from ENE wells. In one well where unfiltered samples were collected, three metals — iron, lead, and manganese — exceeded the standards. The elevated levels are probably due to the high turbidity levels of the water found in that specific well.

The rest of the chemical contaminants tested in the wells fell below the IAC safety standards.

## Has Argonne met requirements set by law?

To be sure that Argonne meets all its legal require-

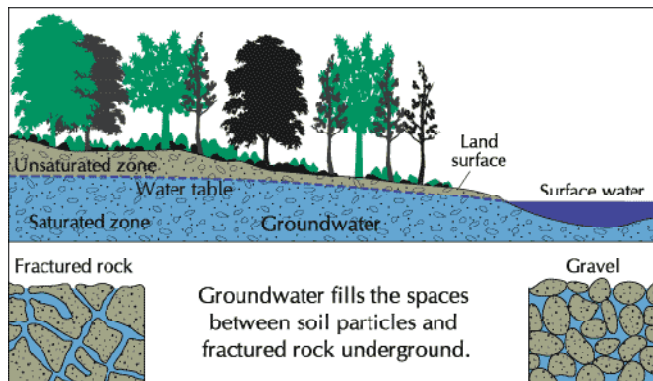


Image compliments of US Geological Survey, adapted by The Groundwater Foundation.

ments, the laboratory established an Environmental Remediation Program. This program is responsible for cleaning up contaminated sites on the Argonne property.

Out of 55 such sites, all but seven were cleaned up to the standards of the Illinois Environmental Protection Agency (IEPA). Under Argonne's long-term environmental stewardship program, these seven units will be monitored and the results reported to the IEPA.

## What is done with contaminated water?

Twenty-five extraction wells were installed within two of the environmental monitoring areas at Argonne. The purpose of these wells was to cut off the flow of contaminated groundwater and send it to Argonne's Wastewater Treatment Plant for processing.

## How do I know that my water is safe?

Several pieces of legislation have been enacted to ensure the safety of the water used by the community. In 1987, amendments to the Clean Water Act significantly changed the focus of regulatory concern to monitoring and controlling contaminants.

In the 1990s, the number of chemical contaminants being monitored was greatly increased. The Safe Drinking Water Act began a program to make drinking water free of harmful materials. This program set such standards as Maximum Contaminant Levels and Maximum Contaminant Level Goals, as well as monitoring requirements and treatment regulations.

# Radiation in general

By Kaye Maloney

To help end World War II, the United States dropped two nuclear bombs on Japan. The nuclear bombs were destructive devices that left behind more than just millions of casualties. There were many long-term effects, like cancer and many kinds of birth defects, from radiation caused by the nuclear explosions. Radiation can be really harmful to people and our environment, which gives us the motive to monitor it.

At the same time, radiation provides many important benefits that help protect and maintain human health and safety. Nuclear medicine procedures are common in today's hospitals, providing diagnostic procedures that quickly and safely identify and treat diseases like cancer. Modern radiology centers rely on X-rays, magnetic resonance imaging and CAT scans. The food industry uses radiation to kill germs to make foods safer to eat and last longer before spoiling.

## What is radiation?

Radiation, also known as radiant energy, is the spontaneous emission of electromagnetic rays or particles from nuclear decay. The three types of radiation are alpha, beta and gamma rays. Gamma rays are the most penetrating and are capable of altering atoms, molecules and disrupting the chemical activity in cells. Beta rays are the second most penetrating, and alpha rays are the form of radiation most easily blocked. A simple piece of tissue paper is enough shielding to stop alpha rays.

## How radiation is measured?

Radiation is measured in units of becquerels (Bq) or in curies (Ci). When radiation is measured in terms of damage to the human body, it's measured in units called rem. One rem of radiation is a fairly large dose equivalent; so many times it is expressed in millirem (mrem), which is 1/1000th of a rem.

One common instrument that measures radiation is a Geiger counter. It is used to check materials and the environment for radioactivity.

## Sources and acceptable dose

Radiation comes from both man-made and natural sources. For most people, natural radiation accounts for the great majority of their radiation exposure. Natural radiation comes from cosmic rays, natural minerals in the

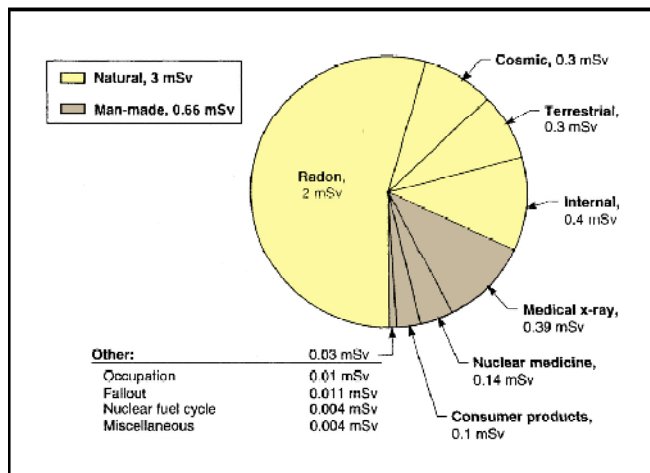


Figure 1: Typical annual radiation doses from natural and man-made sources.

earth, internal radiation from natural minerals in our bodies, and radon. Radon is a radioactive gas formed from the decay of natural radium. Figure 1 shows the most typical sources of radiation exposure for the average person. The main sources of man-made radiation are medical X-rays, nuclear medicine and consumer products.

When an organism receives radiation from a source, the amount is called a dose. A dose of radiation is the amount of radiation received or the amount of energy

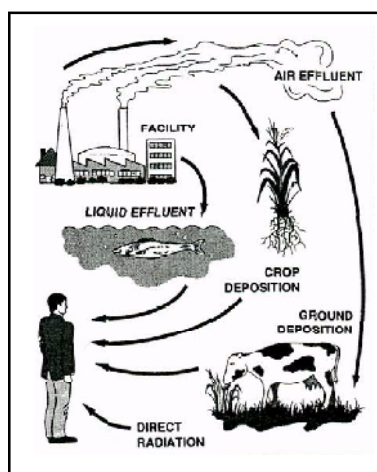


Figure 2: Radiation pathways

that living tissue absorbs. In the United States, the average person receives a yearly dose of 60 mrem of man-made radiation and 300 mrem from natural sources.

If a person receives 50 to 600 rem of radiation in a short period of time, it will cause radiation sickness with different levels of severity. If the dose is on the lower end, the person will live with proper medical attention. If the dose is on the higher end, the person will die within 60 days.

The exposure of man to radiation can be by many routes or pathways. A number of pathways are illustrated in Fig. 2.

# Radiation at Argonne

By Farrah Grysbeck and Lydia Henderson

One of Argonne's major priorities is to make sure that radioactive emissions do not endanger human health, safety, or the environment. If radioactive emissions are not kept to a minimum, then they could prove detrimental to people and the environment. A high level of radiation may cause an increase in cancer, mutations, or other health problems. Argonne activities do not pose a threat to human well-being or the environment, because Argonne is well within the safe range of radiation levels that are set out for them by the laws and regulations regarding radiation. While the average annual dose received by the general public from all radiation sources is 360 mrem/yr, the highest estimated dose anyone might have received as a result of Argonne activities in 2003 was a mere 0.080 mrem/yr.



*Sawmill Creek, which runs through the Argonne site, is tested often for radioactive contamination.*

## Summary of the estimated dose to a hypothetical individual, 2003 (mrem per year)

Pathway	Argonne estimate	Applicable standard
Air total	0.057	10 (EPA)
Water	0.022	4 (EPA) <sup>1</sup>
Direct radiation	0.001	25 (NRC)
Maximum dose	0.080	100 (DOE)

<sup>1</sup> The 4-mrem/year EPA value is not an applicable standard since it applies to community water systems. It is used here for illustrative purposes.

At Argonne, water, air, and bottom sediment are measured to make sure radionuclide emissions are as far below the limits as possible. Sample collections and measurements are made on and off the site for comparison.

Argonne tests for radionuclide emissions in the air by collecting and analyzing air-filter samples. Samples of alpha, beta, and gamma-ray emitters are collected at 12 perimeter locations and at five off-site locations. The radionuclides most tested for are plutonium, thorium, uranium, and strontium, because these are most often found in the air due to Argonne operations. According to the table above, the estimated radiation dose the public might receive from Argonne activities via the air pathway is 0.057 mrem/yr, about 175 times lower than the applicable 10 mrem/yr safety standard.

Radionuclides in surface water are analyzed by performing specific radiochemical separations followed by appropriate counting. All water samples collected are acidified with nitric acid and filtered right after collection. Daily analysis of the main water treatment plant discharge shows hydrogen-3 and possibly strontium-90 have been detected and can be attributed to Argonne operations. Argonne estimates a 0.022 mrem/yr radiation dose from these materials, which is well below safety standards.

Because Argonne wastewater is discharged into Sawmill Creek, the following radionuclides were found in the creek's water: hydrogen-3, strontium-90, neptunium-237, plutonium-238 and -239, americium-241, curium-244 and californium-249. The concentrations of these nuclides are extremely low and not a problem, because Sawmill Creek

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is not used for swimming, drinking, or boating. The only significant location where radionuclides attributable to Argonne operations could be found was in Sawmill Creek, immediately below Argonne's wastewater outfall. Once again, the dose rates were all well within safety standards.

One of the major groundwater contaminants in Argonne's radioactive waste management area is hydrogen-3. This area, which was contaminated in the past by the disposal of liquid wastes to the soil in French drains, is being cleared up by a natural process called phytoremediation and the use of extraction wells.

The radioactivity levels in the bottom sediment in Sawmill Creek are measured with a grab-sample technique. The samples are analyzed after being dried, ground, and mixed. A set of sediment samples collected Oct. 30, 2003, shows that there are elevated, but very low, concentrations of plutonium, americium, and cesium-137 that can be attributed to Argonne wastewater.

External penetrating gamma radiation levels at Argonne are measured with environmental dosimeter chips. Off-site results were 87 mrem/yr, which were lower than last year's average of 93 mrem/yr. The dose rates at the site boundary south of the radioactive waste management area are above the average background. This dose was 103

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*The estimated maximum dose that might be received by anyone living and working around the Argonne boundary is 0.080 mrem/yr, about 1,250 times lower than the 100 mrem/yr safety standard.*

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mrem/yr in 2003, but it has dropped to an acceptable range of 97 mrem/yr about 960 feet south of Argonne's fence. This area immediately south of the fence is dense forest preserve with no homes or other human structures.

Although there are no longer any operating nuclear reactors at Argonne, several facilities do produce fast neutrons that can be released into the environment. Still, Argonne's regular monitoring program found no fast-neutron radiation dose that was measurable.

The estimated maximum dose that might be received by anyone living and working around the Argonne boundary is 0.080 mrem/yr, about 1,250 times lower than the 100 mrem/yr safety standard. It can be concluded that the radioactive emissions from Argonne are extremely low and do not endanger the surrounding environment or the health and safety of the people living near the site.

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## Quality Assurance

**By Lauren Rajski and Sasha Shahnasarian**

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Quality assurance encompasses all the carefully planned activities necessary to ensure that the results of an experiment or analysis are accurate and reproducible. The purpose of quality assurance is to ensure that there are no faults or flaws in the experiments, observations, sampling procedures, or analytical methods. Examples of quality-assurance activities include:

- Using written and approved procedures,
- Applying sampling protocols to make sure that collected samples truly represent what's in the environment,
- Analyzing duplicate samples and data spikes to determine analytical reproducibility,
- Participating in programs to compare procedures and best practices with other groups performing similar tasks.

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*The laboratory sends duplicate samples to independent agencies that perform their own tests to see if Argonne's results were, in fact, correct.*

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To ensure the quality of results from Argonne's environmental sampling and analysis program, the laboratory sends duplicate samples to independent agencies that perform their own tests to see if Argonne's results were, in fact, correct.

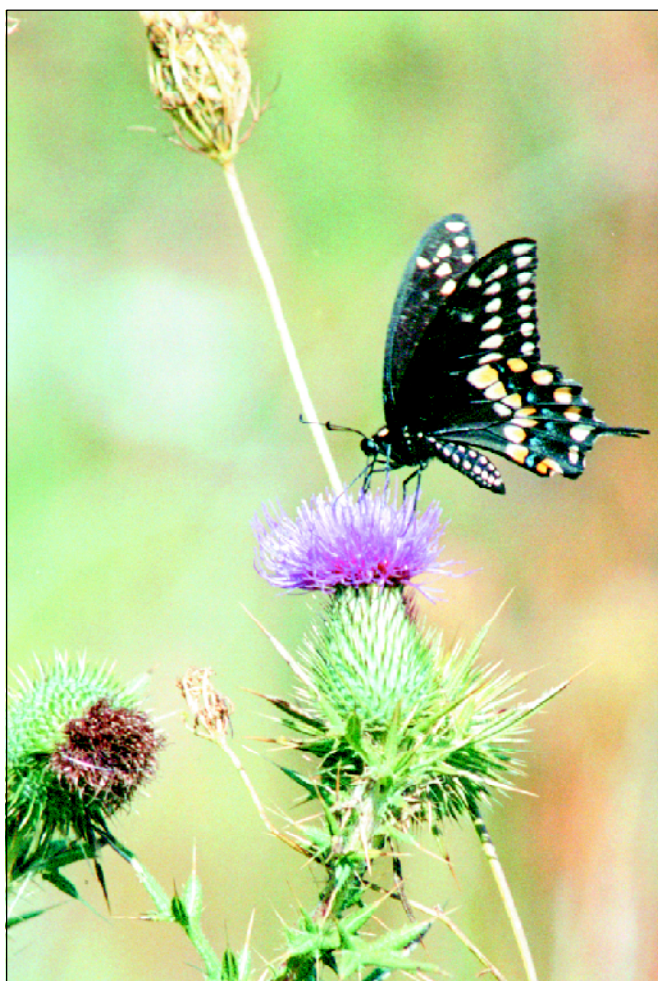
Results from Argonne's participation in the 2003 Department of Energy Environmental Measurement Laboratory Quality Assurance Program indicate that the findings from Argonne's 2004 environmental monitoring program are accurate.

# Solid Waste Management

By Russell Vilorio and Sajitha Abraham

Solid waste is garbage, trash, or refuse that has served its intended use and is being discarded. By monitoring the amounts and types of solid waste we produce, we can forecast future waste management needs for facilities and reduce any harmful effects. Potential harmful effects include infections and chronic diseases from unsanitary conditions that could result from improper disposal of municipal solid waste.

Yeah, the stuff we use and throw out could end up compromising our future. Argonne National Labo-



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*Argonne has created a number of site-wide pollution prevention programs to minimize the amount of waste that Argonne sends to landfills.*

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ratory generates solid waste, monitors it, and treats it properly before disposing it. Argonne creates a large amount and variety of household-type waste and small amounts of radioactive waste.

## Scientific contributions

The scientists at Argonne have treated several areas on the laboratory's DuPage County site that had contaminated soils, ground water, and sediments. A total of 55 contaminated sites required environmental cleanup under the Resource Conservation and Recovery Act. These were mainly locations that had been used to store or dispose of various wastes over the years. The contamination was chemical, radioactive, or both. Argonne has worked closely with the Illinois Environmental Protection Agency (IEPA) to successfully clean up 48 of these sites. The remaining seven are part of the laboratory's long-term environmental stewardship program. The laboratory will continue to monitor them and report its findings to the IEPA.

Argonne has created a number of site-wide pollution prevention programs to minimize the amount of waste that Argonne sends to landfills. Argonne's pollution prevention programs divert waste from landfills, conserve energy, improve indoor air quality and reduce operating costs. Since 1996, these programs have saved Argonne and taxpayers about \$11 million. The program has been declared one of the best in the U.S. Department of Energy national laboratory system.

So next time you flush the toilet, throw that banana peel in the garbage, or experiment with your own radioactive material to propel protons at extraordinary speeds, remember how it would affect our habitats if we didn't have a place like Argonne.

# Wildlife Management

By William Wysocki and Lauren Masterson

As part of protecting the environment, we should do our best to keep it clean and preserve what was here before us. Since forests, prairies, and wetlands surround Argonne, it is necessary to monitor Argonne's effect on the wildlife in this area. The area around Argonne is rich in biodiversity. It provides a home to many forms of wildlife, both plants and animals, including the white-tailed deer and various prairie plants.

## Deer monitoring

Wildlife at Argonne is monitored to evaluate the quality of biodiversity and the effects that Argonne has on the surrounding environment and communities of people.

Biodiversity is the variety of organisms that live in a certain area.

One way that the monitoring is accomplished is by evaluating the number of white-tailed and fallow deer at Argonne. Estimates are made as to how many deer are in the area to determine whether the herds will impact vegetation in the surrounding area. Too large a deer population will eat too much vegetation, threatening the survival of both plants and deer. To help track plant and deer health, Argonne surveys woody vegetation in the fall and herbaceous vegetation and seedlings in the spring. The ideal deer populations are 15 deer per square mile for white-tailed deer and 20 per square mile for fallow deer. When deer populations significantly exceed these levels arrangements are made to thin the herd by killing a limited number of the animals. The deer meat is periodically analyzed to see

if it contains harmful contaminants — it never has — and the meat is donated to charity to help feed the needy.

## Prairie monitoring

Prairies are also an important part of the environment around Argonne; because of their crucial position,



Argonne has started a program to restore these prairies. The prairie restoration program's purpose is to reinstate the prairies in the area and to increase biodiversity. This program is reducing the number of invader species and planting native species in their place.

## Wetland monitoring

There are also wetlands on the Argonne property. One threat to these wetlands is building development on the Argonne site. But Argonne adheres to federal policy by creating new wetlands to replace any

that are put at risk by construction on site. These new wetlands are maintained with native plant species, and the growth of invader species discouraged.

## Endangered species

There are no endangered species present on the Argonne property, but some live around the area. The Hine's emerald dragonfly (*Somatochlora hineana*) lives along the Des Plaines River and so do the Leaf Prairie Clover (*Dalea foliosa*) and the Indiana Bat (*Myotis sodalis*).

A few threatened species live on Argonne property, including the Kirtland's snake, pied-billed grebe, black-crowned night heron, red-shouldered hawk, and the brown creeper.

*Argonne is home to about 40 fallow deer, which have roamed the site since the 1940s. They are descendants of a herd kept by the original owner of the land. Fallow deer are native to parts of Asia. White-tailed deer can also be found on the site, along with many other species of wildlife.*

# Current Environmental Issues

By Sheryl Foster and Meghan Callham

Every year history is made. In 2003, Argonne National Laboratory addressed its own set of current environmental issues and took actions towards solving them. Examples of these issues and actions include compliance with the Clean Water Act-National Pollutant Discharge Elimination System (NPDES), maintaining groundwater quality standards, and phytoremediation. Most of this work has been completed or is ongoing. There is always room for improvement in environmental stewardship.

## Clean Water Act-NPDES

Under the Clean Water Act, Argonne has to take water samples throughout the year and test the samples to make sure that water on the Argonne site meets the



*Fast-growing trees with deep roots are helping to clean up groundwater under a part of the Argonne site.*



requirements of the NPDES permit.

In winter 2003, Argonne took samples from outfalls where salt sometimes collects after it is put on roads to remove ice and make driving safer. Occasionally, this salt can build up until it causes Argonne to violate the permitted standards for total dissolved solids — in this case, the road salt — in water outfalls. Out of 1,600 measurements taken during 2003, only three exceeded the limits on Argonne's NPDES permit. Argonne is working to redirect the runoff from roads into sewers; this approach has proven effective in one area where samples are taken.

## Chlorine

Chlorine is useful in the purification of water, but its concentration in water is regulated because too much can be toxic. Even concentrations that are safe for humans and which help protect our drinking water can be harmful to plants and animals if discharged to the environment without treatment. The discharge of chlorinated water from cooling towers at Argonne occasionally causes violations of the laboratory's NPDES permit. To address this problem, Argonne plans to redirect all these discharges to the sewer system for Argonne's water treatment plant.

## Phytoremediation

Phytoremediation is the use of plants to help remove contaminants from groundwater. This approach is an environmentally safe and economical alternative to more costly methods that involve soil removal and have unwanted side effects on our ecosystem. Some fast-growing plants with deep roots will remove pollutants from groundwater and accumulate it. Later, the plants can be harvested to remove the pollutants. Contaminated soil and groundwa-

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ter that can be treated with phytoremediation may contain traces of radioactive waste, heavy metals and other pollutants. At Argonne, this process is used to treat contaminated groundwater and soil. Wetland plants are studied to help clean up the large amounts of the water brought to the surface from wells. Argonne has been using willow and poplar trees to remove metals from this water.

### Past concerns

In 2003, Argonne completed its remediation studies and continues to monitor and preserve sites where the original concerns took place. Results of the monitoring program will be reported regularly to the Illinois Environmental Protection Agency.



*Above, Lou Martino uses a prototype handheld sensor to measure elemental metals in the soil during a field test of wireless data collection at a contaminated site. Wireless data collection in the field can greatly speed data analysis and mapping at contaminated sites.*

